April 27, 1954 A. Y. DODGE 2,676,667

AIR TREATING APPARATUS

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Fig. 1

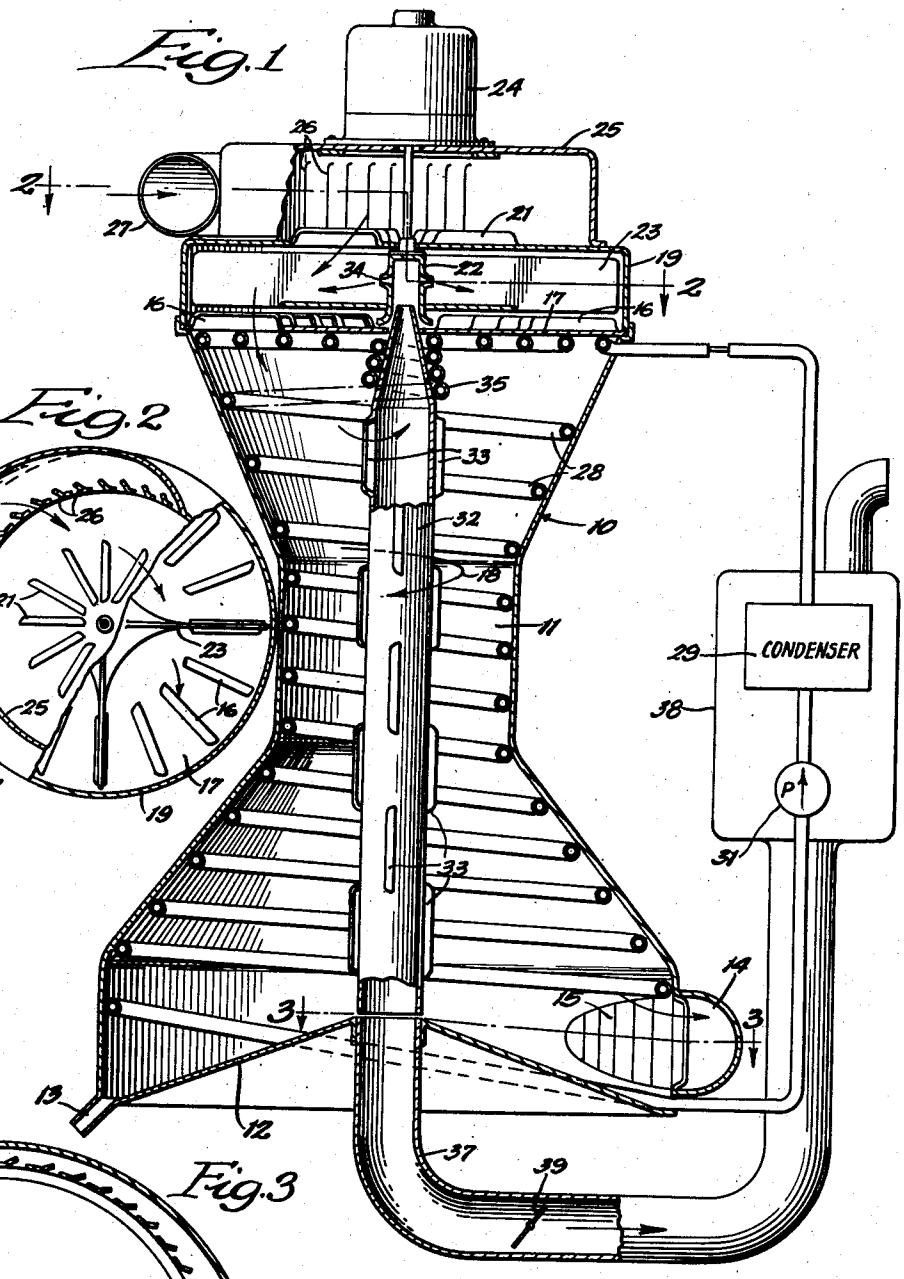


Fig. 2

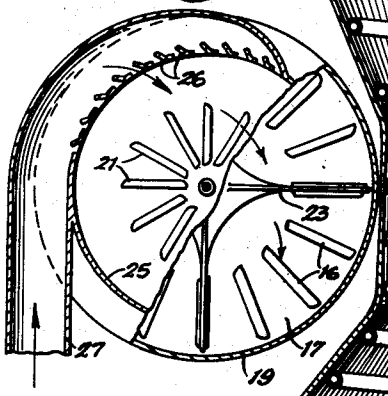
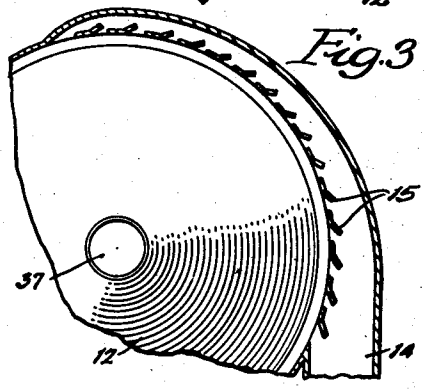


Fig. 3



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AIR TREATING APPARATUS

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11 Claims. (Cl. 183—2)

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This invention relates to air treating apparatus and more particularly to apparatus for cooling and dehumidifying air.

It has heretofore been the common practice in summer air conditioning systems to circulate and cool a relatively small volume of air in proportion to the total volume in the space to be conditioned to a relatively low temperature. Dehumidification has been accomplished by relying on condensation of moisture from the relatively small proportion of the air which is circulated. This practice does not remove sufficient moisture from the air to reduce the humidity to a comfortable level and in many cases results in overcooling.

In my Patent No. 2,519,028, I have proposed an air treating apparatus which circulates a relatively large volume of air in proportion to the total volume in the space and reduces the temperature of the circulated air to a higher level than in the conventional practice. In this apparatus dehumidification is accomplished by causing the air to swirl in the casing to condense moisture against the cooled walls thereof, and, further by separately withdrawing the relatively humid air from the central portion of the whirling mass.

It is one of the objects of the present invention to provide an air treating apparatus of the type disclosed in my Patent No. 2,519,028, in which air is circulated through the casing by a blower so arranged that the natural swirl of air created by the blower impeller will continue throughout the casing to produce a spiral movement of air through the casing.

Another object is to provide an apparatus in which cooling and dehumidification are effected by first cooling the air to its dew point and then separating the relatively unstable mixture resulting into condensate, dry cool air, and humid air by centrifugal force.

According to one feature, the relatively humid air is withdrawn from the central portion of the swirling mass and is returned to the blower inlet to mix with the incoming air and may be additionally cooled to reduce its temperature to a low value.

A further object is to provide an apparatus in which the humid air withdrawn from the central portion of the swirling mass is utilized to help cool the condenser and compressor of a refrigerating apparatus employed to cool the casing.

A still further object is to provide an apparatus in which dust and similar foreign particles are

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removed from the air by centrifugal action and by being mixed with the condensate which collects on the casing walls.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing in which:

Figure 1 is a diagrammatical sectional view of an air treating apparatus embodying the invention;

Figure 2 is a transverse section on the broken line 2—2 of Figure 1; and

Figure 3 is a partial section on the line 3—3 of Figure 1.

The air treating apparatus, as shown, comprises a casing indicated generally at 10 which is hour-glass shaped and circular in section throughout its length. The casing has a relatively large upper end through which air is supplied thereto and tapers conically to a central section 11 of minimum diameter. At its lower part the casing flares outwardly to a bottom of maximum diameter which is closed by an inverted conical bottom plate 12. An outlet 13 for condensate is provided at the bottom peripheral part of the casing. The lower part of the casing at the maximum diameter portion thereof is formed with a main air outlet 14 in the form of a spiral tube extending tangentially outward from the casing. Preferably a louvered arcuate wall 15 is provided at the outlet portion of the casing through which air flows from the casing proper into the outlet conduit 14.

Air is supplied to the upper end of the casing through a series of louvers 16 formed in the outer portion of a plate 17 fitting over the top of the casing. The louvers 16 will direct air passing therethrough tangentially into the casing to cause the air to swirl in a spiral path through the casing as indicated by the arrow 18. The plate 17 forms a part of a blower housing which is completed by a cupped shaped housing part 19 fitting against the plate. In its upper end the housing is provided with an inlet opening formed by a series of tangentially extending louvers 21, positioned near the center of the blower housing. The louvers 21 are directed in the same tangential direction as the louvers 17 to cause a continuous swirling of the air as it passes through the blower housing.

Air is caused to circulate through the blower housing and through the casing 10 by a rotor formed with a hollow hub 22, having a series of blades 23 extending radially therefrom. The blower is driven by a motor 24 whose shaft ex-

tends vertically downwardly to connect to the hub 22.

Air is supplied to the blower from an air inlet chamber 25 mounted above the blower housing and enclosing the inlet louvers 21. Air enters the air chamber 25 through tangentially extending louvers 26 in the side wall thereof which are supplied with air from an inlet conduit 27 lying tangent to the inlet chamber and communicating with the louvers 26 as best seen in Figure 2.

The casing walls and the wall 17 of the blower housing are cooled by a cooling conduit 28 extending spirally inward over the wall 17 and downward through the casing from its upper to its lower end and fitting tightly against the walls of the casing. The conduit 28 serves not only to cool the casing walls but by being connected thereto forms a condensate trough extending spirally from the upper to the lower end of the casing and spirally downward in the same direction as the air travels. Condensate collected in the trough so formed will be carried to the lower end of the casing and discharged through the opening 13.

As diagrammatically illustrated the conduit 28 may form the evaporator of a conventional compression expansion refrigerating mechanism including a condenser 29 and a compressor 31. The condenser is connected to one end of the conduit 28 to deliver liquid refrigerant thereto and the compressor is connected to the condenser to supply high pressure refrigerant vapor thereto to comprise a conventional refrigerating cycle.

In operation of the mechanism since dry air is substantially heavier than water vapor or saturated air, the highly humid air and water vapor will tend to collect near the axis of the casing due to centrifugal action. This humid air is withdrawn through an outlet conduit 32 extending axially through the casing 10 throughout its length and formed with a series of axially spaced louvers 33 extending through the length of the casing. The louvers 33 face in a direction opposite to the direction of air circulation so that they will scoop up the circulating air near the axis of the casing which comprises the humid portion of the air and the water vapor.

According to one feature of the invention, a portion of the humid air which has been cooled below its normal temperature by passage into the cooled casing, is returned to the inlet to mix with incoming air from the space to be conditioned. For this purpose as shown the upper end of the conduit 32 is tapered and fits into the hollow hub 22 of the blower. The hub 22 is formed with a series of outlet ports 34 through which the humid air can discharge radially into the spaces between the blades 23 to mix with air forced into the casing by the blower.

Preferably the humid air so returned is cooled to a temperature substantially lower than the desired discharge temperature to facilitate condensation of moisture from the incoming air. For this purpose a portion of the cooling coil 28 is spirally wrapped around the upper end of the conduit 32 as shown at 35. Preferably the coil 35 is of a size to reduce the temperature of the humid air to a point well below the comfort point, such as 45° F. When this cold air is mixed in the desired proportion with entering warm air from the space and is swirled therewith through the blower and the casing, it will cause condensation of moisture and will effect an efficient cooling of the incoming air to a greater extent than is possible merely by having the air contact the cool container walls.

The remainder of the humid air collected in the conduit 32 may be utilized to assist in cooling the condenser and compressor. For this purpose a conduit 37 connects to the bottom 12 of the casing and forms an extension of the conduit 32. The conduit 37 may be connected to a housing 38 which fits over the condenser and compressor so that cooled humid air discharged through the conduit will be directed over the condenser and compressor to assist in cooling them. The quantity of humid air so discharged over the condenser and compressor may be controlled by a valve 39 in the conduit 37. It is of course also contemplated that additional air from the space or from outside of the space could be supplied to cool the condenser and compressor and may be circulated thereover by the usual fans or blowers not shown. It is also contemplated that condensate discharged through the opening 13 may be directed over the condenser to be vaporated thereon further to assist in cooling.

In operation air from the space to be conditioned enters the inlet conduit 27 and flows tangentially through the louvers 26 into the air chamber 25. This air in a continuation of its initial spiral flow passes through the louvers 21 into the blower casing where its spiral flow is increased by the blades 23 and it is forced in a continuation of the same spiral flow through the louvers 16 and into the casing 10. As the air flows in a spiral path through the casing 10, its velocity and vortex action are increased until the air enters the restricted neck 11 of the casing where its velocity and vortex flow reach a maximum. The air continues in its vortex flow from the lower part of the casing and the cooled dehumidified air which is to be returned to the space is discharged through the louvers 15 into the outlet conduit 14 to be directed back to the space. It will be appreciated that where dehumidification rather than cooling is desired, the air may be warmed in any desired manner, as, for example, by passing it over a portion of the condenser 29.

Due to the high vortex velocity of the air flowing through the casing moisture condensed therefrom will be thrown outward against the walls of the casing and will flow downward along the trough formed by the conduit 28 to discharge through the outlet 13. Any dust or other foreign particles in the air will also be thrown outward by centrifugal force and will be picked up by the condensate and carried out of the casing with it. Thus the air returned to the space is cleaned without the necessity of using any filters and without adding resistance to air flow.

The vortex action will also cause the highly humid air and water vapor to collect near the axis of the casing. The louvers 33 will conduct this portion of the air mass into the outlet tube 32 where a portion of it will be further cooled by the coil 35 and returned to the blower inlet. Mixture of this cooled air with the incoming air and the cooling effect of the plate 17 cool the incoming air quickly to its dew point and swirling of the relatively unstable resulting mixture produces a rapid and efficient separation of the dry cooled air from the vapor and humid air.

It is contemplated that a volume of air which is large relative to the volume of air in the space to be cooled, shall be circulated through the apparatus and that the outlet temperature shall be reduced to approximately the comfort point,

as for example, to 68° F. This air will be dehumidified effectively and cooled to approximately the desired ultimate temperature so that a high comfort level is maintained in the space. At the same time the apparatus can be relatively small and can operate efficiently with a minimum of power consumption.

While one embodiment of the invention has been shown and described in detail, it will be understood that this is illustrative only and is not to be taken as a definition of the invention reference being had for this purpose to the appended claims.

What is claimed is:

1. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing.

2. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing, said outlet conduit communicating with the inlet to the blower whereby at least a portion of the humid air will be recirculated through the casing.

3. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing, said means to cool the casing including a condenser and a compressor and said outlet conduit conducting humid air from the casing over the compressor and condenser to assist in cooling them.

4. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing, said means to cool the casing including a compressor and a condenser, said conduit communicating at one end with the inlet to the blower to recirculate a portion of the humid air through the casing and at its other end discharging humid air over the compressor and condenser to assist in cooling them.

5. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing, said cooling means including a cooling tube extending spirally through the casing in contact with the walls thereof to define a spiral condensate collecting trough and there being an outlet for condensate at the discharge end of the casing adjacent to its periphery.

6. The construction of claim 1 in which the casing is hour glass shaped with enlarged ends and a reduced central portion to increase the air velocity in the central portion of the casing.

7. Air treating apparatus comprising an elongated hollow casing of circular section, a tangentially extending air outlet for the casing adjacent to one end thereof, a centrifugal blower coaxial with the casing at its other end and communicating adjacent to its periphery with the peripheral portion of the casing, the blower forcing air through the casing in a spiral path, means to cool the casing to condense a portion of the moisture in the air, means adjacent to the periphery of the casing to collect condensate thrown out from the air by centrifugal force, and an outlet conduit for humid air extending axially through the casing and being perforated substantially throughout its length to receive humid air from the central part of the casing, said outlet conduit communicating with the inlet to the blower to return at least a portion of the humid air thereto, and cooling means in the conduit to further cool the returned portion of the humid air.

8. Air treating apparatus comprising an elongated hollow casing of circular section, an air outlet at one end of the casing, a blower housing fitting over the other end of the casing, circumferentially extending louvers near the periphery of the housing through which it communicates with the casing, circumferentially extending louvers near the center of the housing defining an air inlet therefor, a vaned rotor in the blower housing to force air therethrough and through the casing in a spiral path, means to cool the

casing to condense a portion of the moisture in the air.

9. Air treating apparatus comprising an elongated hollow casing of circular section, an air outlet at one end of the casing, a blower housing fitting over the other end of the casing, circumferentially extending louvers near the periphery of the housing through which it communicates with the casing, circumferentially extending louvers near the center of the housing defining an air inlet therefor, a vaned rotor in the blower housing to force air therethrough and through the casing in a spiral path, an outlet at the periphery of the casing near its outlet end for condensate, and a discharge conduit for humid air extending axially through the casing and perforated substantially throughout its length to receive humid air from the central part of the casing.

10. Air treating apparatus comprising a hollow casing circular in cross section, an air outlet at one end of the casing, means to force air into the other end of the casing in a spiral path to cause the air to whirl in a vortex through the casing, means to cool air in the casing to a relatively low temperature, and a connection from the interior of the casing to the forcing means to supply a relatively small proportion of cooled air from the casing to mix with the air forced into the casing.

11. Air treating apparatus comprising a hollow casing circular in cross section, a tangentially extending air outlet adjacent to one end of the casing, a closure plate for the other end of the casing having a series of tangentially directed louvers near the periphery of the casing to direct air therethrough, and means to cool the closure plate.

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